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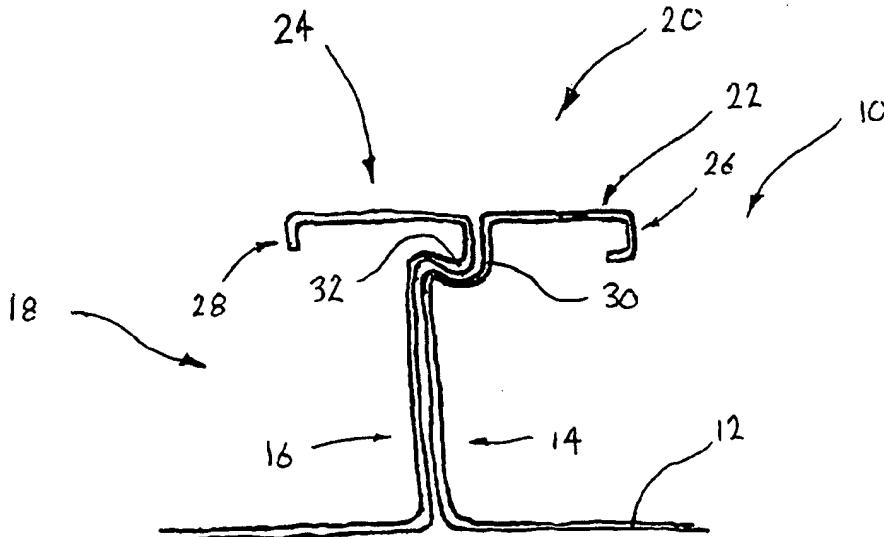
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[Continued on next page]

(54) Title: METAL DECKING



WO 02/38885 A1



(57) Abstract: ABSTRACT The present invention relates generally to a metal decking member (10) being elongate and of a C-section profile including a web (12) and a pair of opposing flanges (14) and (16), respectively. The metal decking member (10) is one of a plurality of metal decking members such as (10) and (18) located alongside one another to together form a metal decking (20). The metal decking (20) is designed to be embedded or clad in a concrete slab so as to form a roof or floor. The flanges (14) and (16) include respective longitudinally extending ribs (30) and (32). The longitudinal ribs (30) and (32) are configured so that adjacent ribs of adjacent decking members interlock to prevent lateral and vertical separation of the metal decking members (10) and (18).



IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Published:**

— *with international search report*

- 1 -

### METAL DECKING

#### FIELD OF THE INVENTION

The present invention relates generally to metal decking and relates particularly, though not exclusively, to a metal decking member for concrete clad roofing or flooring.

#### SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a metal decking member being elongate and of a C-section profile including a web and a pair of opposing flanges each including a longitudinally extending rib being configured wherein said rib can interlock with an adjacent rib of an adjacent metal decking member.

Preferably the opposing pair of longitudinally extending ribs are in transverse cross-section shaped complementary to and are substantially aligned with one another. More preferably said pair of ribs protrude inwardly and outwardly, respectively, of the decking member.

Preferably the opposing pair of ribs are in transverse cross-section shaped wherein adjacent interlocked ribs reside within one another to prevent lateral separation of the adjacent metal decking members. More preferably the outwardly protruding rib of one decking member resides within an inwardly protruding rib of an adjacent decking member.

According to another aspect of the present invention there is provided a metal decking member being elongate

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and of a C-section profile including a web and a pair of opposing flanges, one of said pair of opposing flanges being of a lower stiffness relative to the other of said pair of opposing flanges.

5

Generally the lower stiffness of said one of the flanges is provided by a reduction in the surface area of said one flange relative to the other flange.

10        Preferably one of said pair of opposing flanges is adapted to interlock with an adjacent flange of an adjacent decking member.

15        Preferably the opposing flanges each include a longitudinally extending rib being configured wherein said rib can interlock with an adjacent rib of an adjacent metal decking member.

20        Preferably the metal decking member is of the C-section profile wherein the opposing flanges each having inwardly directed portions. More preferably a free edge portion of each of the inwardly directed portions includes a lip return disposed parallel to the corresponding flange.

25

25        Preferably the inwardly directed portions of each of the flanges includes one or more openings. More preferably said one or more openings are defined by longitudinally extending slits formed in the inwardly directed portions which are deformed out of the plane of the corresponding flange. The openings assist in the venting of air which would otherwise be "trapped" as air pockets within the flanges when pouring concrete across the decking member.

Generally the metal decking member is one of a plurality of metal decking members arranged alongside one another to together form metal decking.

5

It has been found that securing or interlocking of adjacent flanges of adjacent metal decking members of a generally symmetrical configuration restricts or inhibits collapse or rotation of the flanges. In conventional metal 10 decking where the decking members are symmetric and adjacent inwardly and outwardly turned edge portions of the respective adjacent flanges overlap one another, the decking members tend to fail by rotation of the overlapped flanges in the "direction" of overlap.

15

Preferably the web is longitudinally precambered inwardly of the metal decking member. It has been found that longitudinal precambering of the web is effective in increasing the unsupported span of the metal decking 20 member.

Preferably the longitudinal precamber is up to about 2% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a 25 percentage relative to the length of the web. More preferably the longitudinal precamber is between about 0.4% to 1%. In one embodiment this equates to a precamber of between about 20 to 50 mm for an unsupported span of 5 metres.

30

Preferably the web in transverse section is precambered inwardly of the metal decking member. More preferably the transverse pre-camber is up to about 5%

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measured as the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width of the web. Still more preferably the transverse pre-camber is between about 1% to 4%.

5

#### BRIEF DESCRIPTION OF THE DRAWINGS

In order to achieve a better understanding of the nature of the present invention a preferred embodiment of metal decking will now be described, by way of example 10 only, with reference to the accompanying drawings in which:

Figure 1 is a sectional view of one embodiment of a metal decking member according to the invention;

15 Figure 2 is a schematic sectional view of another embodiment of metal decking according to the invention; and

Figure 3 is a perspective view of a further embodiment of metal decking according to the invention.

20 20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figures 1 and 2 there is a metal decking number 10 being elongate and of a C-section profile including a web 12 and a pair of opposing flanges 14 and 16, respectively. The metal decking member 10 is one of a 25 plurality of decking members such as 10 and 18 located alongside one another to together form metal decking 20 (see Figure 2). The metal decking 20 is designed to be embedded or clad in a concrete slab so as to form a roof or floor. In order to avoid repetition and for ease of 30 reference, similar components of the embodiments of the metal decking members 10 of Figures 1 and 2 have been designated with the same reference numerals.

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The adjacent metal decking members such as 10 are of an identical cross-sectional shape being of the C-section profile wherein opposing flanges each include inwardly directed portions 22 and 24. Additionally, each of the 5 inwardly directed portions 22 and 24 include a respective lip return 26 and 28 which is either turned back toward or disposed generally parallel to the corresponding flange 14 or 16.

10 The flanges 14 and 16 include respective longitudinally extending ribs 30 and 32. The longitudinal ribs 30 and 32 are configured so that adjacent ribs of adjacent decking members interlock to prevent lateral and vertical separation of the metal decking members such as 15 10 and 18. This interlocking of the ribs 30 and 32 eliminates the need for fasteners to secure adjacent decking members such as 10 and 18 together. In these embodiments interlocking of the ribs such as 30 and 32 is provided by having the ribs 30 and 32 shaped complementary 20 to and substantially aligned with one another so that one of the ribs such as 30 resides within the other rib 32. The metal decking member 10 of Figure 1 includes a pair of generally C-shaped ribs 30 and 32 which protrude outwardly and inwardly, respectively, of the decking member 10. The 25 C-shaped ribs 30 and 32 are formed in an upright portion of the respective flange 14 and 16. The decking members such as 10 and 18 of Figure 2 include the longitudinal ribs 30 and 32 within the flange adjacent the juncture of the upright portion and the inwardly directed portion of 30 the flange 14 or 16. The ribs 14 and 16 are in this example generally U-shaped in transverse cross-section. The ribs 30 and 32 of both embodiments are roll formed in the respective flange 14 and 16.

Conventional metal decking members are generally of an asymmetric configuration wherein opposing flanges are turned inward and outward respectively. Thus, the

- 5 conventional metal decking is formed by overlapping adjacent flanges. The tendency for conventional metal decking is to fail under load wherein the adjacent overlapping flanges collapse or rotate toward the web of one of the decking members. It is understood that the
- 10 abutting or interlocking flanges of adjacent metal decking members of this embodiment of the invention are less vulnerable to failure in this manner.

According to another aspect of the present invention

- 15 one of the pair of opposing flanges, such as flange 16 of Figure 2, is of a lower stiffness relative to the interlocking flange 14. This is achieved by reducing the surface area or in this example the width dimension of the inwardly directed portion 24 of the less stiff flange 16
- 20 relative to that of the other flange 14. Thus, the less stiff flange 16 has a tendency to deflect or rotate outwardly before the interlocking flange 14. The less stiff flange 16 may be designed to about 90% of the stiffness of flange 14. This reduction in stiffness is
- 25 provided by reducing the surface area of the portion of the flange disposed above the rib for the less stiff flange relative to the corresponding portion of the other flange. In operation, the load of concrete within the metal decking member such as 18 forces interlocking
- 30 engagement of the less stiff flange 16 with the flange 14 of the adjacent decking member 10. The adjacent metal decking members 10 and 18 are thus "tied" together without the need for a fastener which is onerous.

Although not illustrated, the inwardly directed portions 22 and 24 may include openings to allow air to vent from the flanges when concrete is poured across the 5 metal decking. The air may otherwise be trapped as air pockets particularly within the area enclosed by the lip returns 26 and 28 of the inwardly directed portions 22 and 24, respectively. The openings are formed by a plurality of longitudinally extending slits in the inwardly directed 10 portions 22 and 24 which are pressed upward out of the plane of the respective flange. In one embodiment the slits are formed as transversely spaced pairs each of a length of about 8 mm and the adjacent inwardly directed portion such as 22 is pressed about 3 mm out of the plane 15 of the respective flange. The slits formed in the flanges also promote the engagement of concrete with the decking member.

Figure 3 illustrates a further embodiment of the 20 invention where the web 16 of the metal decking member 12 is longitudinally pre-cambered inwardly of the metal decking member 12. For clarity the metal decking member is depicted without the longitudinally extending ribs. The metal decking member which ordinarily is embedded in a 25 concrete slab (not shown) is thus capable of spanning an increased distance unsupported. The precamber of the web 16 is in this example about 0.6% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a percentage relative to the length 30 of the web 16. It is understood that the longitudinally precambered web 16 is at least partly deflected toward the flat plane under the significant weight of the concrete slab. Advantageously, this longitudinal precamber provides

minimal deflection of the metal decking member 12 which spans increased distances. In this embodiment the metal decking member 12 spans up to about 5 metres unsupported and includes a longitudinal precamber of about 30 mm which 5 corresponds to 0.6 percent. The unsupported span of 5 metres of this embodiment of the intention compares to a span of up to 3 metres for conventional decking without a longitudinal precamber.

10        Although not clearly illustrated the web 16 of the metal decking member 12 may also be pre-cambered in transverse sectional profile inwardly. The transverse pre-camber of the web 16 in this example is approximately 2% measured as the maximum offset of the web 16 from a 15 substantially flat plane and expressed as a percentage relative to the width of the web 16. In this example the metal decking member 12 has a width of approximately 300 mm and is roll formed from sheet metal of a thickness of about 1.2 mm.

20        The longitudinal precamber in the web 16 of the metal decking member 12 is formed by corrugating the web 16. The corrugations (not shown) are oriented transverse and extend partly across the width of the web 16. The 25 transverse corrugations are cold roll formed in the web 16 are sufficiently "light" to provide the preferred longitudinal precamber of up to about 2%. The corrugations may be formed either in the flat strip or in the web 16 once it is formed into the C-section profile. Otherwise, 30 corrugation of the web 16 is performed via corrugating rolls (not shown) in a conventional cold roll forming manner.

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Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. For example, the longitudinal ribs of the opposing flanges

5 may vary in configuration provided they permit interlocking of adjacent decking members. The less stiff flange may vary in construction from that described provided it promotes interlocking of adjacent flanges of adjacent decking members. Preferably the web is

10 longitudinally and/or transversely precambered inwardly of the decking member whereby it can span increased distances unsupported. All such variations and modifications are to be considered within the ambit of the present invention the nature of which is to be determined from the foregoing

15 description.

In the preceding summary of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising" 20 is used in the sense of "including", that is the features specified may be associated with further features in various embodiments of the invention.

## THE CLAIMS:

1. A metal decking member being elongate and of a C-section profile including a web and a pair of opposing flanges each including a longitudinally extending rib being configured wherein said rib can interlock with an adjacent rib of an adjacent metal decking member.
2. A metal decking member as defined in claim 1 wherein the opposing pair of longitudinally extending ribs are in transverse cross-section shaped complementary to and are substantially aligned with one another.
3. A metal decking member as defined in claim 1 or 2 wherein said pair of ribs protrude inwardly and outwardly, respectively, of the decking member.
4. A metal decking member as defined in claim 3 wherein the opposing pair of ribs are in transverse cross-section shaped wherein adjacent interlocked ribs reside within one another to prevent lateral separation of the adjacent metal decking members.
5. A metal decking member as defined in claim 3 or 4 wherein the outwardly protruding rib of one decking member resides within an inwardly protruding rib of an adjacent decking member.
6. A metal decking member being elongate and of a C-section profile including a web and a pair of opposing flanges, one of said pair of opposing flanges being of a lower stiffness relative to the other of said pair of opposing flanges.

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7. A metal decking member as defined in claim 6 wherein the lower stiffness of said one of the flanges is provided by a reduction in the surface area of said one flange  
5 relative to the other flange.

8. A metal decking member as defined in claim 6 or 7 wherein one of said pair of opposing flanges is adapted to interlock with an adjacent flange of an adjacent decking  
10 member.

9. A metal decking member as defined in any one of claims 6 to 8 wherein the opposing flanges each include a longitudinally extending rib being configured wherein said  
15 rib can interlock with an adjacent rib of an adjacent metal decking member.

10. A metal decking member as defined in any one of the preceding claims wherein the metal decking member of the  
20 C-section profile includes the opposing flanges each having inwardly directed portions.

11. A metal decking member as defined in claim 10 wherein each of the inwardly directed portions includes a lip  
25 returned disposed parallel to the corresponding flange.

12. A metal decking member as defined in claim 10 or 11 wherein the inwardly directed portions of each of the flanges includes one or more openings.

30  
13. A metal decking member as defined in claim 12 wherein said one or more openings are defined by longitudinally extending slits formed in the inwardly directed portions

which are deformed out of the plane of the corresponding flange.

14. A metal decking member as defined in any one of the  
5 preceding claims wherein said member is one of a plurality  
of metal decking members arranged alongside one another to  
together form metal decking.

15. A metal decking member as defined in any one of the  
10 preceding claims wherein the web is longitudinally  
precambered inwardly of the metal decking member.

16. A metal decking member as defined in claim 15 wherein  
the longitudinal precamber is up to about 2% measured as  
15 the maximum longitudinal offset of the web from a  
substantially flat plane and expressed as a percentage  
relative to the length of the web.

17. A metal decking member as defined in claim 15 or 16  
20 wherein the web includes transversely oriented  
corrugations which are effective in the longitudinal  
precambering of the metal decking member.

18. A metal decking member as defined in any one of the  
25 preceding claims wherein the web in transverse section is  
precambered inwardly of the metal decking member.

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19. A metal decking member as defined in claim 18 wherein the longitudinal precamber is up to about 2% measured as the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width  
5 of the web.

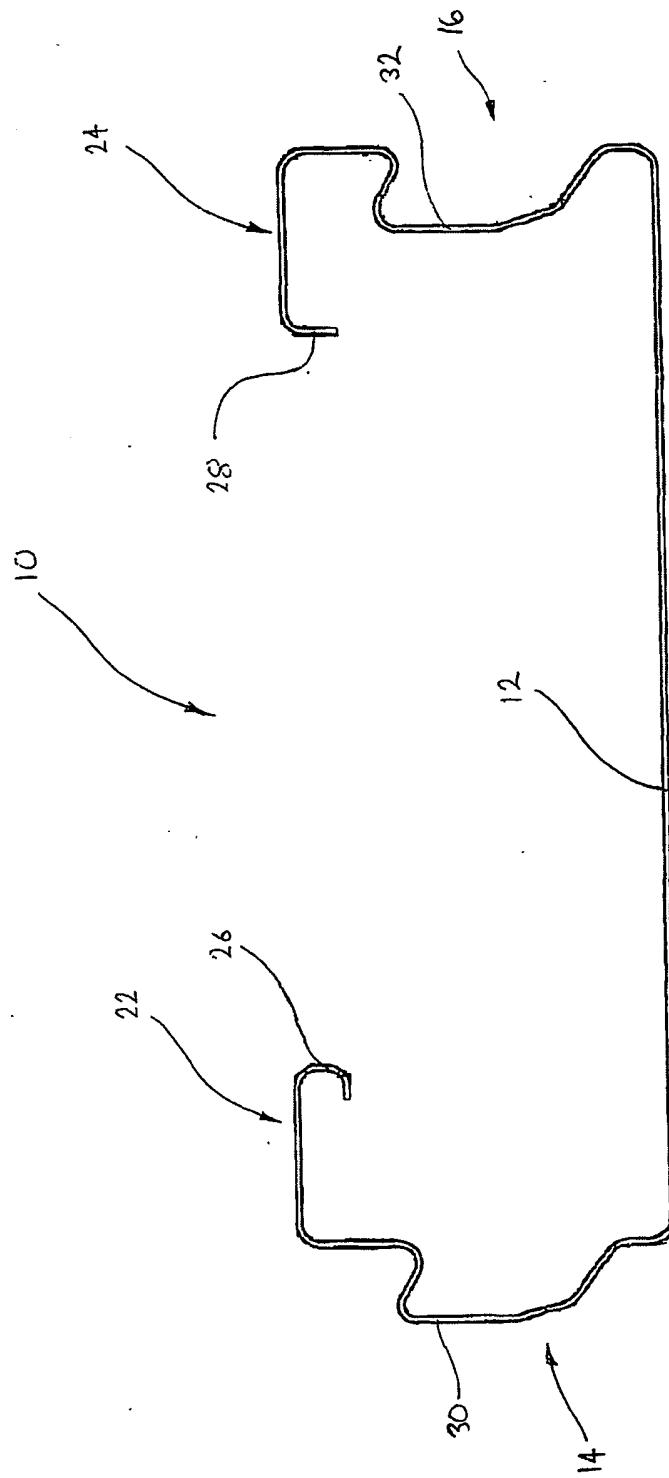


FIG. 1

2/3

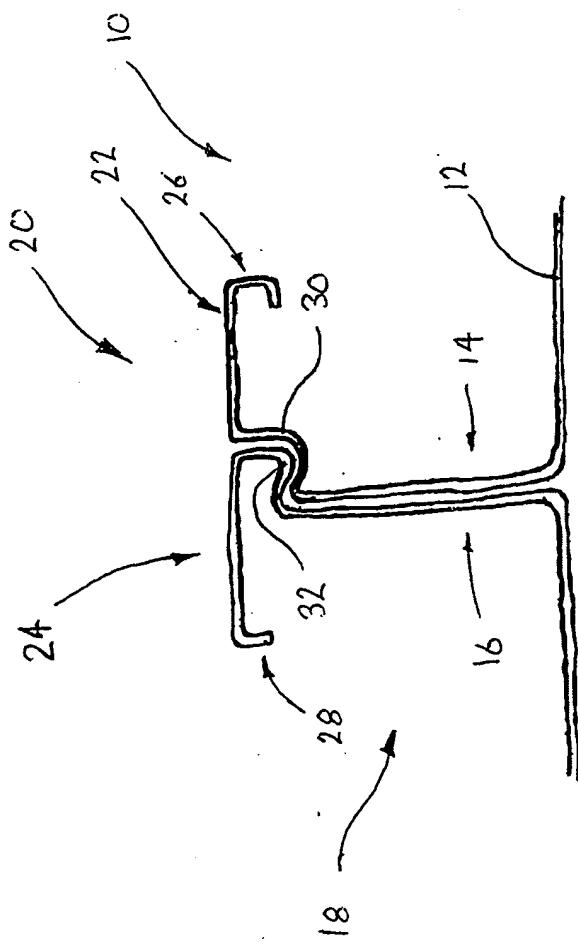


FIG. 2

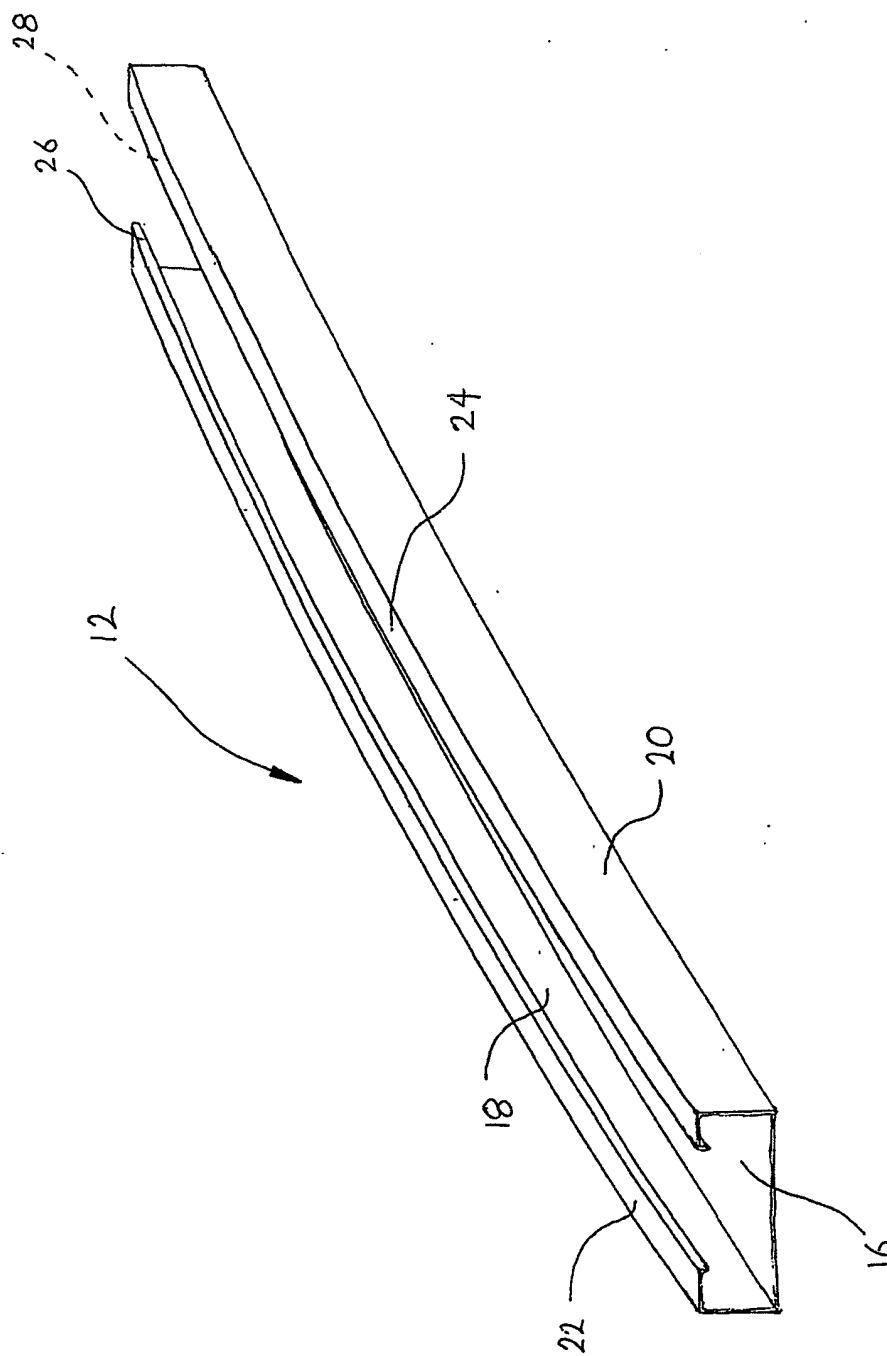


FIG. 3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/01446

## A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. 7: E04D 3/363, E04B 9/04, 5/32

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Refer Electronic data base consulted

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI IPC E04B 5/-, 9/-, E04D 3/-, E04G 11/- and Keywords (roof, floor, deck, metal, aluminum, steel, clad, interlock, mate, snap, web, flange, rib) and like terms

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00/63504 A (DAMPA A/S et al) 26 October 2000 entire document	1-10, 12, 14, 18-19
Y	page 5 lines 30-32	18 -19
X	WO 97/40243 A (BHP STEEL [JLA] PTY LTD et al) 30 October 1997 entire document	1-10, 12, 14, 18-19
Y	page 5 lines 23-30	18 -19
Y	EP 606146 B (HUNTER DOUGLAS INDUSTRIES B.V.) 13 July 1994 drawings	18-19
Y	AU 53050/59 B (237706) (CHARLES SMITH) 24 March 1960 drawings	18-19

Further documents are listed in the continuation of Box C  See patent family annex

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance  
 "E" earlier application or patent but published on or after the international filing date  
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  
 "O" document referring to an oral disclosure, use, exhibition or other means  
 "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  
 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone  
 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  
 "&" document member of the same patent family

Date of the actual completion of the international search <b>3 January 2002</b>	Date of mailing of the international search report <b>10 JAN 2002</b>
Name and mailing address of the ISA/AU <b>AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929</b>	Authorized officer <b>JAGDISH BOKIL Telephone No : (02) 6283 2371</b>

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/01446

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 86/00363 A (BLAZLEY) 16 January 1986 drawings	1-9, 14, 18-19
X	FR 2641812 A (PROFILAFROID SA - FR) 20 July 1990 figures 1-3	1-9, 14
A	US 3902288 A (KNUDSON) 2 September 1975 drawings, column 3 lines 23 - 53	
P, A	JP 2001152674 A (REITO KK) 5 June 2001 figure 6	
O	"The Standard Mill Shapes Rolled", Roltech Industries Inc [online], [retrieved from the Internet on 2002-01-03 <URL: <a href="http://www.roltech.com/rolled.htm">http://www.roltech.com/rolled.htm</a> >] see shape type 8	15-17
In assessing the inventive step of claims 18-19, the third and fourth citations which are of "Y" category may be combined with any one of the first two citations.		

**INTERNATIONAL SEARCH REPORT**

International application No.  
**PCT/AU01/01446**

**Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos :  
because they relate to subject matter not required to be searched by this Authority, namely:

2.  Claims Nos :  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.  Claims Nos :  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

**Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

SEE EXTRA SHEET

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

The additional search fees were accompanied by the applicant's protest

No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU01/01446

## Supplemental Box

(To be used when the space in any of Boxes I to VIII is not sufficient)

## Continuation of Box No: II

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. The International Searching Authority has found that there are different inventions as follows:

1. Claims 1-5 and claims 10-19 (depending on claims 1-5) are directed to a metal decking member of c-section profile including a longitudinally extending rib that can interlock with an adjacent rib of an adjacent metal decking member. It is considered that the longitudinally extending rib that can interlock with an adjacent rib of an adjacent metal decking member comprises a first "special technical feature".
2. Claims 6 -9 and claims 10-19 (depending on claims 6-9) are directed to a metal decking member of c-section profile including opposite flanges of different stiffnesses. It is considered that the opposite flanges being of different stiffnesses comprises a second "special technical feature".

Since the abovementioned groups of claims do not share any of the technical features identified, a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept, *a priori*.

INTERNATIONAL SEARCH REPORT  
Information on patent family members

International application No.  
PCT/AU01/01446

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report			Patent Family Member				
WO	9740243	AU	25617/97	CN	1218530		
US	3902288	AU	51855/73	CA	985869	CA	997917
		DE	2305620	DE	2365729	FR	2172250
		GB	1418407	US	3842647	US	3967430
FR	2641812	NONE					
WO	8600363	AU	45485/85	CA	1268310	CA	1298053
		CN	85105818	EP	219498	IN	163833
		NZ	212583	SG	999/93	US	4759159
		ZA	8504858	US	4896466		
JP	2001152674	NONE					
EP	606146	AU	53014/94	BR	9400031	CN	1094777
		JP	6341193	SG	48699	US	5475962
WO	200063504	AU	200041002	DK	521/99		
END OF ANNEX							

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